actions of muscles, would lead us to suppose that the fibres of the motor nerves are continuous with those of the cerebellum; but hitherto no observations have been made which prove the existence of this connexion; and it is the object of the author, in this paper, to establish, by a more careful examination of the anatomical structure of this part of the nervous system, such continuity of fibres between the anterior columns of the spinal cord and the cerebellum. The corpora pyramidalia have been hitherto considered as formed by the entire mass of the anterior, or motor columns of the spinal cord; but the author shows that not more than one half of the anterior columns enters into the composition of these bodies: and that another portion, which he terms the *antero-lateral* column, when traced on each side in its progress upwards, is found to cross the cord below the corpora olivaria, forming, after mutual decussation, the surface of the corpora restiformia; and ultimately being continuous with the cerebellum. These fibres are particularly distinct in the medulla oblongata of the sheep and of the horse. The author conceives that the office of the antero-lateral columns is to minister to the involuntary, as well as to the voluntary movements: that the facial nerve arises from both the voluntary and involuntary tracts; and that the pneumogastric nerve arises both from the involuntary and the sensory tracts.

June 9, 1836.

FRANCIS BAILY, Esq., V.P. and Treasurer, in the Chair.

"Discussion of the Magnetical Observations made by Captain Back, R.N., during his late Arctic Expedition. By Samuel Hunter Christie, Esq., M.A., F.R.S.

The author, having been consulted by Captain Back, previous to the departure of the latter, in 1833, with the expedition for the relief of Captain Ross, respecting the nature of the magnetical observations which it might be desirable to make in the regions he was about to visit, and considering that, with a view to the attainment of the principal object of the expedition, the greatest economy of time in making these observations was of the first importance, limited his suggestions, in the first instance, to the methods proper to be employed for determining the direction and the dip of the needle, but more especially the latter. Captain Back, immediately on his return, placed all his magnetical observations at the disposal of Mr. Christie, who having since completed their reduction, gives, in the present paper, the results of his labours.

The first part of the paper relates to the observations of the Dip of the magnetic needle. With a view to economize as much as possible the time consumed in making each observation, the process of inverting the poles of the needle, which is usually resorted to in each instance, was here dispensed with. But in order that the dip may be determined independently of this operation, it is necessary not only that the position of the centre of gravity of the needle employed should be ascertained, but that it should be permanent. In giving an account of the observations made to verify this condition, the author com-

mences with those at Fort Reliance, which was the first winter station of the expedition; and where the dip was determined by observations of the needle, both with direct and also with inverted poles. The author then enters upon an investigation of formulæ for the determination of the dip by means of a needle, in which the value of a certain angle, denoted by the symbol γ, determining the position of the centre of gravity, has been ascertained; and, conversely, for the determination of the value of the same angle, or, which is equivalent to it, the position of the centre of gravity of the needle, when the dip at the place of observation is given. He next inquires whether any tests can be applied to the observations under discussion, which may indicate the extent of the errors by which the results deduced from them may be affected; and he employs for this purpose the values of the terrestrial magnetic intensity furnished by certain equations obtained in the preceding investigation; making the proper allowances, first, for the needles used being ill adapted to this method of determining the relative intensities; secondly, for errors of observation in determining the times of vibration of the needle; and thirdly, for disturbing causes which might affect the observations. Considerable differences were found to exist in the results obtained by the two methods, at New York, Montreal, Fort Alexander, Montreal Island, and Fort Ogle; differences which can be accounted for only by errors in the assumed magnitude of the angle γ, and which, consequently, indicate the want of permanence in that angle. It was necessary, therefore, to inquire what changes in the angle γ will account for these discrepancies, and how far the value of the dip, thus obtained, may be affected by them. Formulæ are then deduced by which these changes may be determined.

From a comparison of the observed and computed values of the angles involved in these investigations, the author infers that the differences between those of one of these angles are, with a few exceptions, contained within the limits of the errors incident to dip observations: but with respect to the other angle, they in general exceed those limits. Upon the whole, he concludes that the discrepancies which appear between the values of the terrestrial intensity, as deduced from the times of vibration of the needle, and from the observed angles of inclination to the horizon, are principally attributable to a want of absolute permanence in its axis of motion. In the present case, the centre of gravity of the needle being nearly coincident with the axis, a very minute derangement in that axis would cause a considerable change in the value of the angle γ; so that the existence of differences in the values of this angle do not warrant the inference that the needle itself received any serious injury during the expedition; to which, indeed, from the care taken of it by Captain Back, it could not well have been liable.

The second part of the paper relates to the observations of the variation of the magnetic needle, which are already published in Capt. Back's narrative, and which are here introduced for the purpose of applying them, in conjunction with the observations of the dip, detailed

in the preceding part, to a formula deduced from theory, with the view of ascertaining how far they may tend to support that theory.

The third section is devoted to the comparison of the observations of the dip and variation of the needle with theoretical results of a more general kind. The observations made by Captain Back are peculiarly adapted for verifying the hypotheses on which the theories of terrestrial magnetism rest, and that theory, in particular, which assumes the existence of two magnetic poles, symmetrically situated in a diameter of the earth, and near to its centre: for, on this hypothesis, the poles of verticity and of convergence will coincide; and the tangent of the dip will be equal to twice the tangent of the magnetic latitude. In no case has a progress towards the magnetic pole been made so directly, and to such an extent, as in the present expedition; whether that point be considered as the point of convergence of magnetic meridians, or that at which the direction of the force is vertical. It is deducible from the theory that the product of the tangent of the dip by the tangent of the polar distance is equal to two: and therefore, if the distance of the pole of convergence from two stations be determined by means of the observed variations at those stations, we may estimate, by the approximation of this product to the number two, in each case, the degree of coincidence which exists between theory and observation. A table is then given, exhibiting the several data on which this comparison is made, and the results deduced from them. From an inspection of the numbers in the column which indicate the deviations from theory it appears that there is not, in general, that accordance between the observations and the theory which might reasonably have been expected; and that although that theory may serve as a first approximation, yet it requires to be considerably modified to reconcile it with the observations. Hence the author arrives at the general conclusion that, unless considerable errors have crept into the observations of either the dip or the variation, the theoretical pole of verticity does not coincide with the pole of convergence, even when the positions of these points are deduced from observations made at very limited distances from those poles.

"On the Safety-valve of the right Ventricle of the Heart in Man; and on the gradations of the same apparatus in Mammalia and Birds." By J. W. King, Esq. Communicated by Thomas Bell, Esq., F.R.S.

In this paper additional evidence is given by the author in corroboration of the principles which he had announced in a former communication, which was read to the Royal Society in May 1835, on the influence of the tricuspid valve of the heart on the circulation of the blood. His object is to demonstrate that the tricuspid valve in man occasionally serves the purpose of a safety-valve, being constructed so as to allow of the reflux of the blood from the ventricle into the auricle, during the varying states of distension to which the right cavities of the heart are at times subjected; that a similar function is maintained in the greater number of animals possessing a double circulation, and also that in the different orders of these animals the structure of this